GAS JOURNAL, FEB. 12, 1941

VOL. 233 93rd YEAR No. 4056

EDITORIAL NOTES

THE CALENDAR AND DIRECTORY

WE offer our apologies to " JOURNAL " subscribers on the delayed despatch of the 1941 edition of the Calendar and Directory, but it will, we hope, be appreciated that this delay has been occasioned solely by wartime conditions. We hope and believe that its usefulness will be ample recompense for its somewhat tardy appearance. Certainly nothing has been left undone by way of checking, compiling, and revision to render this year's volume as reliable and as informative as were previous editions. Regarding one feature our hands have been tied. The shadow of the censor fell on the statistics relating to the coal carbonized, coke made, and gas manufactured by individual undertakings. This ruling was reasonable enough, and naturally we have not the least desire to publish any information whatever likely to be of assistance or guidance to the enemy. In the circumstances we took the view that the interests of all concerned would best be served by repeating the figures current at December, 1939. This course, we considered, would at least give the enquirer a proportionate picture of each undertaking in Great Britain, while disclosing no " abnormalities " consequent upon war effort and fluctuating load. Of course, every change in personnel has been noted, and as further changes take place—and such occurrences are frequent in wartime—we shall, as before, notify subscribers through the " JOURNAL," thereby ensuring, as far as we are able to ensure, a very correct Directory.

New matter has been added to the 1941 edition, and quite a number of modifications have been made to render the Calendar a sensible and serviceable wartime guide. We may mention, for example, the incorporation of succinct notes on legislation imposed by hostilities—that is, of course, particular legislation directly affecting our Industry. We think this section will prove a useful reference—and this, too, can without much trouble be kept up to date individually. As far as the Handbook portion is concerned (we ourselves refer to it a good deal in our daily work as scribes) we have added, amended, and deleted as befits the times. To itemize alterations here we consider unnecessary, though attention might perhaps be called to several British Standard Specifications recently issued, and quoted in the Handbook, relating among other subjects to the calorific value of coal, the sampling of coke, and the dimensions and weights of lightweight and heavyweight steel tubes. And we offer no apology for including a series of tables on the comparative costs of carbonization in vertical and intermittent vertical retort and chamber installations operating under various conditions. We regard these tables, originating from the work of the Woodall-Duckham Companies, as of considerable importance.

Nor does the utility of the Calendar and Directory end with what can justly be regarded as a wealth of statistical and technical information. The 1941 edition, in common with its predecessors, is a thoroughly good buyers' guide. Our advertisement section constitutes a reflex on the stability of the Gas Industry as a whole in times of severe stress ; and it is with considerable pride—pride quite apart from that as publishers—that we can in 1941 record an increase in advertisements in the Calendar over those in the 1940 edition, which went to press in far more quiescent, far less troublous circumstances. In brief, we think we are right to assume that the latest " JOURNAL " Calendar is a wholly encouraging index to the position of the Gas Industry of this country after seventeen months of modern warfare.

NAPHTHALENE FOR MOTOR TRANSPORT

WE wrote in our issue of Jan. 29 on the subject of using creosote, in substitution for imported fuel oils, for motor transport, mentioning specifically the work undertaken at Belfast and Salford since the last war. Those investigations were begun in 1929 at Belfast and in 1932 at Salford, and we outlined the outcome of them. Under peacetime conditions the results could be looked upon as satisfactory and promising, and it seemed to us that the whole problem was worthy of more intense research and development. It would appear, however, that comparatively little attention was paid to the matter by the Gas Industry as a whole in the subsequent years of quietude when tankers of magnitude brought to our shores abundant supplies of oil. In the circumstances of to-day we think that more thought and greater action might well be directed to the more extensive employment of home-produced fuels—gaseous, liquid, and solid fuels resulting from the carbonization of coal.

Last week we published a letter from Mr. T. O. Wilton, who referred to the work which his father did, when Superintendent of the Tar Works at Beckton, on the utilization not only of creosote, but also of solid naphthalene, in the early part of the last war. Then the use of naphthalene was suggested as one of the practicable solutions of the motor-fuel problem—naphthalene having the great advantage of cheapness. Provision has to be made for melting the fuel before it can be passed into the carburettor. It was found that this heating could be effected conveniently by jacketing the fuel reservoir and downtake pipes with a fraction of the exhaust gases, or circulating water from the engine cylinders. It was necessary to run on petrol till the naphthalene container and passages from it to the carburettor had been melted free, and this warming occupied about ten or fifteen minutes. Actually the patents relating to the use of naphthalene are notably of French and German origin, experiments being conducted in those countries as long ago as 1907 and with a considerable measure of success, one of the methods being to dissolve the naphthalene in petrol. In the middle of 1914, it may be mentioned, there were about 1,000 naphthalene engines (stationary as well as mobile units) at work in Germany, compared with 68 in 1911. As far as we are aware all the units were working on the Otto cycle.

There was also some notable work undertaken in this country during the last war by Messrs. J. H. Willis and G. G. Wilson.

of the Birmingham Gas Department, who pointed out that there was no need to use commercially pure naphthalene for the purpose. Naphthalene has a calorific value of round about 17,400 B.Th.U. per lb., compared with a calorific value of 18,700 B.Th.U. per lb. for petrol. For a given thermal output it is bulkier, but it is easy to handle, safe, and extremely easy to compress. The exhaust is good, and it was found that the consumption of cooling water and lubricating oil were small. The naphthalene engine obviously shows to the best advantage in works in which it is required to run for long periods after starting. At the present juncture it is interesting to recall a statement made by Mr. Willis in an article published in the "JOURNAL" during the war—an article describing the work carried out at Birmingham. It was: "The use of naphthalene as a fuel for small engines can be greatly extended with advantage, and attempts which war conditions have provoked are likely to end in the ultimate adoption of naphthalene as a fuel for commercial motor vehicles." As we have said, it appears that the matter was not pursued to any extent on the resumption of peace, but now, once again under wartime conditions, further work on the subject seems to be indicated.

A TRIBUTE TO GAS

ON another page of this week's "JOURNAL" will be found a message from Lord Woolton to the Gas Industry, in which the Food Minister expresses his appreciation of the great assistance he has received on the Kitchen Front. In addressing himself to the Industry Lord Woolton says: "You have helped the Ministry of Food greatly"—a high tribute indeed from the Minister of Food himself. "During the last 25 or 30 years we have established in this country a remarkably high standard of living. Every new scientific device has been brought to bear on our comfort," says Lord Woolton, and in this achievement the Industry has played a large part.

A great deal of energy has, indeed, been devoted to the Food Education Campaign, and the Industry has every reason to be proud of the way in which the Home Service "Front-Line Troops" have responded to the national call. They have intensified and extended their splendid peacetime work through the framework of the National Food Campaign, and for the guidance and assistance they have given to the public Lord Woolton says, "I thank you most warmly." There will, we know, be as energetic a response as ever to the new efforts which the Food Minister calls for on the Kitchen Front in 1941. We even hope that some gaps which have existed may be filled. In his message to the Gas Industry Lord Woolton appeals to the hundreds of demonstrators to show the housewife just how "to get the best out of the home-produced foods at her disposal." Demonstrators can play their part in the national effort by continuing to show the housewife how to make the most of simple foods, and by revealing to her the "art" of cooking them in such a way as to make them interesting and appetizing. Lord Woolton particularly mentions our very fine supplies of potatoes, carrots, and oatmeal, of which he is specially urging the public to make the most, and no doubt, with the help of the Home Service personnel, it will not be long before the housewife is saying of oatmeal what Lamb said of brawn—"It is a noble thought. It is not every gullet-fancier that can properly esteem it. Its gusto is of the hidden sort. It will be wooed and not unsought be won."

"Journal" Indexes

Several enquiries which have reached us recently concerning the non-appearance in the "JOURNAL" of recent quarterly indexes reveal that our notice in this connexion was missed by some readers.

For the sake of paper economy we decided, as from the September quarter, not to include the index in every copy, but to post it separately only to those who specially applied for it. Application is required only once, because we keep a register for the purpose, and those subscribers who are on it will receive the index automatically as it appears each quarter.

We shall be pleased to add any names to the list, and to supply back numbers within the limits of a small stock.

Personal

Manchester Appointment.

Mr. ROWLAND WALKER, A.M.I.Mech.E., has been appointed Chief Engineer of the Manchester Gas Department. He was educated at the Leeds Central High School and the Leeds Technical School. His early training was in the works and laboratories of the Farnley Iron Co., Leeds, under Professor J. W. Cobb, and he had experience under Dr. E. W. Smith on the trial installation of Koppers Coke Ovens and Mond Gas Plant at Birmingham. He then transferred to the Engineering Staff of the Birmingham Corporation, under Mr. W. Chaney, Engineer at Saltley, and was later appointed Junior Engineer at the Windsor Street Works, under the late Mr. J. Foster, Chief Engineer.

In 1918 Mr. Walker was appointed Shift Superintendent at the Bradford Road Works, Manchester, and later Works Superintendent. He was transferred to Gaythorn Works as Manager, and in 1929 appointed Manager of the new Partington Gas-Works. He has specialized in the recovery of by-products and producer gas practice.

During the Great War Mr. Walker served with the Mediterranean Expeditionary Force and was mentioned in despatches.

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Kirkcudbright Town Council have agreed to the nomination of Bailie MILBURN as Convener of the Gas Committee in succession to Councillor Burden, who has resigned.

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Mr. H. MAINWARING, M.C., M.Inst.Struct. E., has been appointed Distribution Engineer to the Manchester Corporation Gas Department. He was formerly Distribution Superintendent.

Obituary

R. G. Shadbolt

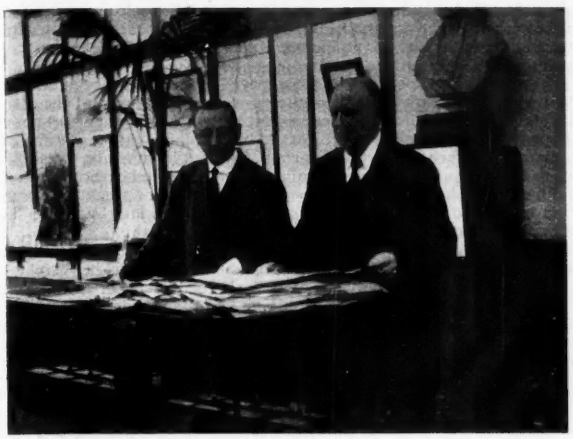
Mr. ROBERT GEORGE SHADBOLT passed peacefully away on Feb. 6, at the Queen Elizabeth Hospital, Birmingham. He had undergone two operations, from which he was recovering very well when he had an unexpected relapse about ten days ago. He was 73 years of age.

Mr. Shadbolt's family connexion with the Industry dates back to the period when gas was first introduced at Cambridge in 1825. The next two generations each produced a Robert Shadbolt, who in turn became Works Manager of that Company. The second Robert Shadbolt was the first to strike out from Cambridge, becoming Manager of the Biggleswade Gas Company, which he served up to the time of his death. His sons were all brought up at Cambridge and afterwards dispersed to different quarters, mostly continuing to hold positions in the Gas Industry. The third Robert Shadbolt, father of Mr. R. G. Shadbolt, was Manager first at Waterbeach, Cambridge, then at Broseley, Shropshire, and finally at Fleetwood, where he served as Engineer, Manager, and Secretary up till the time of his death. Of his six sons, five were trained as Gas Engineers by him—the eldest, Mr. R. G. Shadbolt, being the fourth Robert in direct succession. The fifth Robert—elder son of R.G.—was Assistant Engineer and Manager at Redhill, and subsequently at Ascot until his death in 1930 at the early age of 37.

In 1892 Mr. R. G. Shadbolt left Fleetwood to become Engineer and Manager of the late North Brierley Gas Company, Yorkshire, a position he held for three years. He was subsequently Engineer, Manager, and Secretary of the Grantham Gas Company for 25 years, until his retirement in June, 1920, to devote himself to private practice. His younger son, Ernest, succeeded his father at Grantham before joining him in the consulting practice which he set up in Birmingham. This is, perhaps, a unique record of one family's association with the Gas Industry.

Mr. Shadbolt made many valuable technical contributions to the

Industry, being associated in the design of the Kirby-in-Ashfield Gas-Works, which were inaugurated in 1906. His remarkable abilities were recognized by his election in turn to the Presidencies of the Manchester Association of Gas Engineers in 1899 and of the Eastern Counties Association in 1905, while in 1911 he attained to the highest position with which his professional colleagues in the Industry could honour him—namely, President of The Institution of Gas Engineers. In 1912 he was elected an Honorary Member of the North British Association. In 1921 he was Chairman of the National Association of Technical Gas Officials. A keen Freemason, Mr. Shadbolt was a P.M. of Doric Lodge No. 362. He celebrated his Golden Wedding Anniversary in 1939.



Mr. Robert Shadbolt, with his elder son, photographed at the National Gas Exhibition, Birmingham, in 1923.

He was President of The Institution of Gas Engineers in the year which saw the formation of the B.C.G.A., and became the first President of the first body to undertake co-operative advertising in this country. It must have been a great source of satisfaction to him to see the tremendous progress made by the Association through the years, and he must have considered himself well rewarded for the work and energy he put into its organization. Up to recently, Mr. Shadbolt was still a familiar and active figure at Gas Industry gatherings, and was a working member of the Central Committee of the B.C.G.A. and of the Central Executive Board of the National Gas Council. His loss will be felt through out the Industry.

He is survived by a widow, two daughters, and his son, Ernest, who is carrying on the consulting practice in which he was assisting his father. The funeral was at Brandwood End Cemetery, Birmingham, on Monday.

Kenneth Aird

The funeral of the late Mr. Kenneth Aird took place on Feb. 4 at Blairlogie Church, Bridge of Allan. Among those present were : Mrs. Aird, widow, Lieut. Peter D. M. Aird, son, Miss Penelope Aird, daughter, and other relatives of the family ; Mr. James A. Maclay, a Director of Glover & Main, Ltd., Mr. T. McEwan, Mr. Sam Hall, and Mr. H. Macpherson, representatives of Glover & Main, Ltd., Mr. G. W. Wortley, General Manager of R. & A. Main, Ltd., Falkirk, and members of the Staff at Falkirk.

A large number of wreaths were sent from relatives, Directors, staff, and employees of R. & A. Main, Ltd., and Thomas Glover & Co., Ltd., London, Edmonton, Falkirk, and Branches.

A Memorial Service was held on Feb. 5 at St. Michael's Church, Chester Square, London, the Rev. C. H. S. Kew officiating. Among those present were: Miss Lilian Aird, Mrs. and Miss Jorgensen, Mrs. and Miss Ashby, Mr. D. Hargrove, Mrs. S. H. Hargrove, Rev. D. Duval, Sir Ernest Hiley, K.B.E. (Deputy-Chairman of Glover & Main, Ltd.), Major A. L. S. Wood, Mr. S. E. Wood, Mr. J. A. Maclay, Colonel and Mrs. W. R. Glover, Mr. A. J. Crichton, Secretary, Mr. Brian Wood (representing Sir David Milne-Watson), Dr. W. T. K. Braunholtz (Secretary of The Institution of Gas Engineers), Mr. W. H. Ballantyne, Mr. T. E. Bartram (Messrs. Boult, Wade & Tennant), Mr. Rupert King ("GAS JOURNAL"), Mr. Andrew Leach (*Gas World*), Mr. A. J. Healey, Mr. and Mrs. C. Marley, Mr. J. S. Wilson, Mr. G. F. Jenkins, representatives of R. & A. Main, Ltd., and Thomas Glover & Co., Ltd., and Main Water Heaters, Ltd. The Service was choral and Mr. Francis T. Kennard, a senior member of the staff, was at the organ.

As we go to press we learn with regret of the death at his home at Huddersfield on Feb. 9 of Mr. P. F. HOLMES, J.P., Chairman of Messrs. W. C. Holmes & Co., Ltd. An obituary notice will appear in our columns next week.

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Mr. BARTHOLOMEW WILLIAM ALDWINCKLE, of Tinwell, Stamford, a Director of the Stamford Gas Company since 1934, died on Feb. 4 at the age of 68.

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Food Education Campaign

Lord Woolton thanks the Industry

The January issue of *Home Service* publishes the following message specially addressed to the Gas Industry by the Minister of Food :

" During the last 25 or 30 years we have established in this country a remarkably high standard of living. Every new scientific device has been brought to bear on our comfort, and in the matter of food we have been particularly fortunate. Goods have been brought to us from all over the world and sold at cheap prices. In time of war it is no longer possible to bring the world to our door. A large proportion of our shipping must be diverted for sterner purposes, and food imports reduced to a minimum. A few days ago I asked the people of this country to adopt as their wartime food maxim the slogan ' Eat British.' By so doing they will be helping to shorten the war. Thanks to the splendid efforts of our farmers and growers, we have in this country very fine supplies of potatoes, carrots, and oatmeal. Each is rich in food value and available everywhere at reasonable prices.

" I believe that the health of the nation will be enormously improved if we make the right use of such simple foods as these. Is that too much to ask ? Is it too much to ask the housewife, when she finds that supplies of this commodity or that are not coming to her with the clockwork regularity which she received in peacetime, to be ready to switch over to simpler ways of living ? I know it is not. The public wants to be told what each one of us can do to bring us Victory and Peace.

" The housewife may say that the simple diet is more difficult to make interesting ; that is where the Gas Industry can play its part. Everyone knows that it is the art of cooking, the art of preparing the meal, that tempts the appetite. I want to appeal to all of you, to the hundreds of demonstrators whose services the Gas Industry has so freely placed at our disposal, to show the housewife just how to get the best out of the home-produced foods at her disposal.

" You have helped the Ministry of Food greatly in the past, and I thank you most warmly for that help. I know that we can count on you to make new efforts on the Kitchen Front in 1941."

Institution of Gas Engineers

The following meetings of The Institution of Gas Engineers and the Gas Research Board have been provisionally arranged to take place in February and March :

Tuesday, Feb. 18 : 11 a.m., Gas Education Executive Committee ; 2 p.m., Gas Education Committee.

Tuesday, March 4 : 2 p.m., Chairmen's Technical Committee.

Monday, March 10 : 1.45 p.m., Finance Committee ; 2.15 p.m., Membership Committee ; 3 p.m., General Purposes Committee.

Tuesday, March 11 : 10 a.m., Council.

Thursday, March 13 : 2 p.m., Refractory Materials Joint Committee.

Tuesday, March 18 : 2 p.m., Gas Education Executive Committee.

Friday, March 21 : 12.15 p.m., Liquor Effluents and Ammonia Committee.

Friday, March 21 : 2 p.m., Joint Research Committee.

Tuesday, April 1 : 12 noon, Finance Committee ; 2 p.m., Council.

Friday, April 18 : 2 p.m., Joint Committee on Complete Gasification under Pressure.

Communal Catering

Communal feeding is an important wartime problem, and we learn with interest of the services offered by Messrs. James Stott & Co. (Engineers), Ltd., who are at all times pleased to offer the assistance of their Engineers and Planning Department to co-operate in producing the most practical layout and equipment of feeding centre kitchens. These services are entirely gratis, and all are welcome to take advantage of the offer in order to meet quickly a wartime emergency.

A further order for emergency catering has just been given to the Company by the Oldham County Borough, the contract consisting of the complete equipment of a feeding centre capable of catering for approximately 350 persons. Two service points are to be arranged, one to deal with persons consuming food, and one to deal with " cash and carry " customers. The centre is to be known as the Wellington Restaurant, and a rough guide to the equipment to be installed is as follows : Cooking range and roasting oven, automatic food steamers, boiling tables, bain marie, mixing and mincing machines, vegetable bins, dish washer and water heater, potato chipper, boiling pans, hot cupboards, water boiler and tea-making urn, potato peeler and preparation sinks, refrigerator, slicing machine, and cafetaria tray rails.

The Minister of Labour and National Service has made Regulations prescribing standards of lighting in certain classes of factories. It will be recalled that the Regulations were issued in draft last Autumn. The regulations as made are substantially similar to those issued in draft, the main difference being that the list of classes of works of a special character in the schedule to which the Regulations apply only in a somewhat modified way has been extended. The Regulations came into force on Feb. 1. Employers, if they have not already done so, should take steps at once to bring their lighting installations into conformity with the Regulations, which are entitled the *Factories (Standards of Lighting) Regulations*, 1941.

BENZOLE RECOVERY BY ACTIVATED CARBON

[Contributed]

THE value of the activated carbon system for the recovery of benzole from coal gas has been amply demonstrated by the performance of the activated carbon benzole recovery plant installed at the Beckton Works of the Gas Light & Coke Company, details of which have appeared from time to time in the Technical Press.

Since the system has marked advantages in comparison with the well-known oil-wash benzole recovery process, the question naturally arises as to the reasons why the activated carbon system has not been adopted more extensively in the Gas Industry. The Beckton plant, which is of a very large capacity, requires considerable supervision since it is not automatically controlled, and it is perhaps principally due to this feature that the translation of the system to other undertakings, especially the smaller ones, has not gone ahead.

The problems associated with the design of an activated carbon system which is entirely automatic in operation and which requires as little supervision as the oil-wash process have now been solved by Messrs. Sutcliffe, Speakman & Co., of Leigh, Lancashire. Messrs. Sutcliffe Speakman, the largest manufacturers of activated carbon in the world, who possess unrivalled knowledge of the recovery of all types of organic solvents by this means, have now placed on the market automatically operated plants suitable for the recovery of benzole both in large and small gas-works.

The plants are built in two sizes of unit. The smaller unit has a capacity of half a million cu.ft. of gas per day ; the larger unit will deal with one and a quarter million cu.ft. of gas per day. Where a small gas undertaking has a maximum make of one million cu.ft. of gas per day, two of the smaller units can best be installed, so that when the make of gas is at a minimum one unit can be completely closed down. For the bigger undertakings multi-units of the larger capacity are used, and at present one such plant is being installed to recover benzole from a daily make of five million cu.ft.

The advantages claimed for the Sutcliffe Speakman activated carbon system may be briefly summarized in the following manner :

1. The plant is entirely automatic in operation. Any adjustments to the plant can be carried out in a few minutes and the change-over to a fresh charge of activated carbon, at long intervals, is clean and rapid.
2. The benzole distilled from the carbon is water-white. It does not require extensive rectification since it does not contain any of the absorbing agent.
3. The plant exerts only a small back pressure on the exhauster.
4. The stripped gas is very low in organic sulphur compounds. A gas containing 8 grains of sulphur per 100 cu.ft. is readily obtained.
5. The carbon and steam requirements of the system are such that the cost of benzole recovery is competitive with the best practice in oil-washing.
6. The highest possible yield of benzole is obtained.
7. A relatively small amount of ground space is occupied by the unit. Overhead tanks or platforms are unnecessary.

The successful operation of the activated carbon system is dependent on certain essentials being observed. The gas and steam must pass alternately through the bed of activated carbon in the opposite directions so that the minimum penetration of impurities of high molecular weight into the bed occurs. The benzole should not remain in contact with the activated carbon for an unduly long period ; it should be removed as rapidly as possible. High temperatures should be avoided during the recovery of the benzole from the activated carbon ; prolonged heating of the activated carbon at elevated temperatures results in accelerated depreciation of the absorptive properties of the activated carbon.

In the Sutcliffe Speakman system special attention has been devoted to the above essentials, while at the same time the design of the plant has been made as simple as is consistent with satisfactory performance. In order that the back pressure exerted by the plant shall be minimized, as large a surface of activated carbon as possible must be presented to the ingoing gas. A much smaller size of activated carbon can thus be used, which ensures economy in the quantity of steam necessary and efficient drying of the activated carbon at a later stage in the operation of the plant.

Operation of a half-million cu.ft. per day unit over a period of some months at a gas-works employing horizontal retorts has provided the following data. The yield of benzole recovered per ton of coal carbonized varied from 3.5 to 4.2 gallons, and the efficiency of recovery was of the order of 95%. The sulphur content of the untreated gas was 20 to 30 grains per 100 cu.ft. ; the sulphur content of the stripped gas was 5 to 8 grains per 100 cu.ft.

The quality of the benzole is indicated by the analysis which follows :

Specific gravity 15°/15°	0.8745
Distillation test, N.B.A. flask method.	
Drip point	72.6°C.

Temperature °C.	Per cent. by volume
80	4.0
90	41.5
100	68.5
110	78.0
120	83.0
130	87.0
140	90.0
150	93.0
160	95.0
170	96.0
Total distillate	97.0
Flask residue	2.0
Distillation loss	1.0
	100.0

Leverhulme Research Fellowships, 1941

Application is invited for (i) Fellowships, or (ii) Grants in aid of research. The Fellowships or Grants are intended for senior workers who are prevented from carrying out research work by routine duties or pressure of other work. They are limited to British-born subjects normally resident in Great Britain. In exceptional circumstances the Trustees may waive the condition as to residence.

The Trustees are also prepared to consider applications from groups of workers engaged upon co-operative programmes of research—particularly from those engaged upon long-distance programmes or in Institutions in which the normal facilities for research have been curtailed by the war. The duration of the awards will not normally extend over more than two years or less than three months, and the amount will depend on the nature of the research and the circumstances of the applicant.

Forms of application may be obtained from the Secretary, Dr. L. Haden Guest, M.C., M.P., Leverhulme Research Fellowships, Kingscote House, 1, Watergate, Blackfriars, London, E.C. 4. Applications must be received on or before March 1. Awards will be announced in July and will date from Sept. 1.

A Simple Form of Gauge for checking low values of illumination is described in Specification BS/ARP 30, and this specification has now been followed by one describing a simple portable standard of brightness BS/ARP 52. This Standard is intended to provide a rough check on the brightness of surfaces, and the nominal brightnesses specified correspond to the brightness values used for various A.R.P. purposes. Copies of this Specification may be obtained from the British Standards Institution, 28, Victoria Street, S.W. 1, price 6d., post free 8d.

Gas Undertaking Results

Durham

The Directors of the City of Durham Gas Company state, in their report to the shareholders for the year to December last, that progress has been made with reference to the supply of gas from coke ovens, and commencement of delivery will take place in the very near future. The total revenue for the year shows an increase of £3,479 over that of the preceding twelve months, while expenditure has risen by £1,550. chiefly through higher coal costs and increased wages. The gross profit is thus £1,929 more than a year ago. The Revenue Account shows a profit for the year of £6,244, and with the sum brought forward there is a balance of £8,229 for appropriation. Dividends for the year of 5% on the original capital and 3½% on the ordinary capital compare with 7½% and 5¼% respectively for the year 1939.

Weymouth

Sales of gas by the Weymouth Consumers' Gas Company during 1940 amounted to 1,423,600 therms, which is practically the same as in the previous year. Higher costs rendered necessary an increase in the price of gas as from the June quarterly readings by 1d. per therm, and again in September by another 1d. per therm. The balance of revenue carried to Net Revenue Account on the present occasion is £7,978, which compares with £6,980 a year ago. A dividend for the year of 5½% on the ordinary stock compares with 6% paid for the previous year.

Accrington and District Gas and Water Board have lent £10,000 to Accrington's War Weapons Week.

The Following Meetings of the London and Counties Coke Association have been arranged for Feb. 17 at Gas Industry House : Finance Committee, 11 a.m. ; Executive Committee, 11.30 a.m. ; Central Committee, 2 p.m.

WAR EMERGENCY LEGISLATION AFFECTING GAS UNDERTAKINGS

THE emergency legislation placed on the Statute Book immediately preceding the outbreak of war in September, 1939, was largely amended and extended during 1940, while the Statutory Rules and Orders issued under these Acts of Parliament continue to be added to—at an average rate of nearly 200 a month.

Of these, many Acts and Orders have a direct or indirect application to the Gas Industry, and the following article is an attempt to summarize the position as at the end of 1940—both as regards the legislative provisions and the general bulk of legislation.

Generally speaking, the emergency legislation referred to below is applicable to the United Kingdom ; in cases where its adaptation to Scotland, Northern Ireland, or London is modified, this is indicated by initials prefixed to the titles of the Statutes, as under :

(S.) Applicable, with modifications, to Scotland.
(N.I.) Applicable, with modifications, to Northern Ireland.
(X.S.) Not applicable to Scotland.
(X.N.I.) Not applicable to Northern Ireland.
(S.O.) Applicable to Scotland only.

The principal Statutes which comprise the foundation of War Emergency Legislation include (in chronological order) the following :

Civil Defence Act, 1939 (S., X.N.I.).

Under it, public utility undertakings were required to report on measures taken for the training of employees in air raids precautions (*section 36*), and to act on a notice from the Board of Trade to take other measures (*section 37*). Contributions towards the cost of such work were provided by Exchequer grants (*sections 38, 39*).

Ministry of Supply Act, 1939.

The Minister of Supply is empowered to direct that required work shall have priority over other work, and to appoint controllers (*section 7*). The *Priority of Work Order*, 1939 (No. 1080)—under Regulation 55 of the *Defence* (*General*) *Regulations*, 1939—authorizes the issue of priority certificates in respect of the supply of the necessary materials, and (under the same Regulation) " controls " have been established.

War Risks Insurance Act, 1939 (S., N.I.).

Provision is made for the insurance against war loss and damage of goods in the United Kingdom, by a scheme operated by the Board of Trade (*sections 7–15*). Under Part II of this Act (as amended by various *Defence* (*War Risks Insurance*) *Regulations*) the scheme was made compulsory in respect of all goods held for sale ; exemption is granted, *inter alia*, in respect of :—

(i) Goods, the value of which does not exceed £1,000 (*War Risks* (*Compulsory Insurance of Commodities*) *Order*, 1940, No. 785).

(ii) Coal, coke, coal tar pitch and manufactured fuel, gas supplied by public utility undertakers, gas oil owned by the producers of such gas, and

(iii) Goods forming the subject of a hire-purchase agreement (*War Risks Insurance* (*General Exceptions*) *Order*, 1940, No. 294).

The current rate of premium—in respect of the three months commenced Dec. 3, 1940, is fixed at 7s. 6d. per cent. per month (*War Risks* (*Commodity Insurance*) (*No. 9*) *Order*, 1940, No. 2015).

War loss or damage for the purpose of insurance is defined by the *War Risks* (*Commodity Insurance*) (*No. 5*) *Order*, *1939* (No. 1731).

It is to be noted that the *War Damage Bill* recently introduced proposes to amend Part II of the 1939 Act.

Emergency Powers (Defence) Act, 1939.

The current Regulations and Orders under this statute (as amended by the *Emergency Powers* (*Defence*) *Act*, 1940), are summarized later under this heading.

Courts (Emergency Powers) Act, 1939 (X.S., N.I.).

It is provided that before proceeding to exercise a remedy available by, *inter alia*, taking possession of property or by realization of any security, the leave of the appropriate court is required (*section 1*). The " appropriate court " is designated by the *Courts* (*Emergency Powers*) (*Consolidation*) *Rules*, 1940 (No. 408).

In the Chancery Division of the High Court in 1939, Morton, J., held that the cutting-off of the gas supply to a prepayment-meter consumer for non-payment of arrears of instalments under a hire purchase agreement was not in the nature of a " realization of a security " within the meaning of Section 1 of this Act (*Perry* v. *South Metropolitan Gas Company*). Although the leave of the Court was held to be unnecessary in these circumstances, it is to be noted that the case was decided on the construction of the Company's private Act of Parliament.

The Act is extended by the *Possession of Mortgaged Land* (*Emergency Powers*) *Act*, 1939, and the *Courts* (*Emergency Powers*) *Amendment Act*, 1940.

Essential Buildings and Plant (Repair of War Damage) Act, 1939 (S., X.N.I.).

The Treasury is empowered to approve loans for the rebuilding of works and reinstatement of plant which has suffered war damage, in circumstances where the undertaking is carried on wholly or partly for purposes essential to the welfare of the civil population.

Compensation (Defence) Act, 1939 (S., N.I.).

It is provided (*section 13*) that where compensation is to be paid in respect of property subject to a hire-purchase agreement, the hirer may claim an apportionment of the compensation payable. Payments under this Act carry interest at the rate of 2% from the date on which they accrue.

War Damage to Land (Scotland) Act, 1939 (S.O.).

The rights and liabilities are modified in relation to land in Scotland damaged by enemy action.

Although the Acts set out above were placed on the Statute Book before the war, they are properly regarded as part of the Emergency Legislation.

Liability for War Damage (Miscellaneous Provisions) Act, 1939

Where loss or damage arises from enemy action, relief is given from the liability to repair damage or replace goods and to continue to pay for hire (*section 1*).

Control of Employment Act, 1939 (X.N.I.).

Under this Act the Minister of Labour and National Service has issued the *Control of Employment* (*Advertisements*) *Order*, 1940 (No. 522) which prohibits employers engaged in the building industry and in civil engineering contracting from publishing advertisements for certain classes of employees, except with the consent of the Minister.

Courts (Emergency Powers) (Scotland) Act, 1939 (S.O.).

This Act applies to Scotland, with modification, some of the provisions of the *Courts* (*Emergency Powers*) *Act*, 1939, already referred to.

Gas and Steam Vehicles (Excise Duties) Act, 1940.

Goods vehicles driven by gas or steam are subject to reduced rates of excise duties, as from Jan 1, 1940.

Rating and Valuation (Postponement of Valuations) Act, 1940.

The making of the third quinquennial re-valuation list is postponed until not later than the second year after the end of the present emergency ; the right to obtain a revision of the valuation, however, in specified circumstances, is not affected (*section 1 (2)*).

Special Enactments (Extension of Time) Act, 1940 (S., N.I.).

The time enacted for the discharge of duties imposed, or the exercise of powers conferred by local or private Bill legislation and for the exercise by public utility undertakings of powers to purchase, or of re-entry, may be extended (by not more than three years) by an Order under this Act.

Courts (Emergency Powers) Amendment Act, 1940 (N.I.).

The Act of 1939 (referred to above) is amended to provide, *inter alia*, that the prohibition of execution on judgment orders—except by leave of the Court—shall be extended to property (other than land) by reason of a default in the payment of money and to remedy the position disclosed in the case of *S. & A. Services, Ltd.* v. *Dickson* (1940) relating to an action for the possession of goods.

Orders under the Emergency Powers (Defence) Acts, 1939 and 1940.

I. (S., N.I.) Defence (General) Regulations, 1939 (No. 927—as amended).

Regulation 4 B provides for the prohibition of the erection or display of place names and for the removal, obliteration, or concealment of such signs. This power is exercised as specified in the *Removal of Direction Signs Orders*, 1940 (Nos. 1007 and 1377) which prohibits the display of any reference to the geographical situation which could be seen from a highway, a train, or low-flying aircraft.

Regulation 19 B provides for the regulating of the supply and storage of fuel and lubricants for motor vehicles. Any person who supplies or stores specified petroleum or benzole products (including gas oil, pitch, &c.) must obtain the approval of the Secretary for Petroleum (*Petroleum* (*No. 3*) *Order*, 1940, No. 962).

Regulation 21 provides that an area may be declared, by Order, an evacuated area. Reference is made, below, to the *Defence* (*Evacuated Areas*) *Regulations*, 1940.

Regulation 24 provides for the control of lights and sounds. Thereunder, the Secretary of State has issued the *Lighting* (*Restrictions*) *Orders* and the *Control of Noise* (*Defence*) (*No. 2*) *Order*, 1939 (No. 1544).

Regulation 26 provides that a gas undertaking may cut-off supplies to premises as long as they are unoccupied.

Regulation 27 A provides for the appointment of fire-watchers. This has been made compulsory for premises where more than thirty persons are employed (*Fire Watchers Orders*, 1940, No. 1677.)

Regulation 36 provides for the precautions to be taken in connexion with the storage of all fluids giving off an inflammable vapour below 150° F.

Regulation 53 (1) provides for the requisitioning of property (other than land) in the United Kingdom. Owners of privately-owned railway wagons were required to inform the Railway Executive Committee of the number and particulars of such wagons owned

at the date of the outbreak of war and subsequently (*Railway Wagons (Notification of Particulars and Plating) Order*, 1939, No. 1911). The Minister of Transport has given notice to requisition (with specified exceptions) these wagons (*Requisitioning of Privately-owned Railway Wagons Notice*, 1939, No. 1085) which pass under the control of the Railway Executive Committee (*Railway Control Order*, 1939, No. 1197), representing the Main Line and other specified companies. The latest " Notice " (1940, No. 2164) requisitions such wagons the construction of which has been completed since Oct. 8, 1940.

Regulation 53 (4) empowers the prohibition of the removal of articles on hire-purchase from premises in certain circumstances.

Regulation 54 AA provides that public utility and other undertakings may be given power to suspend statutory restrictions on the carrying on of essential work.

Regulation 54 C empowers the Minister of Supply to declare an undertaking to be a " controlled " undertaking.

Regulation 55 provides for the general control of industry ; it enables the production or excessive consumption of articles of any description to be regulated, partially restricted or prohibited (except under licence) and for maximum or basic prices to be fixed.

The rationing of coal, coke, &c., gas, and electricity supplied to domestic and small industrial consumers (*Fuel and Lighting Orders*, 1939, Nos. 1028 and 1640) has been suspended, in respect of gas and electricity, by the *Fuel and Lighting Order*, 1940 (No. 24).

Under this Regulation, however, the Mines Department is empowered to direct the restriction of supplies to small gas consumers (*Control of Coal and Regulation of Consumption of Gas and Electricity Order*, 1940, No. 1284).

As to coal tar oils used as motor fuel reference should be made to the *Motor Fuel Rationing Orders*, 1939 (No. 1271) and 1940 (Nos. 826 and 1489).

Other " controls " which have been established and are still in force include the following :

The purchase or sale of unregistered goods vehicles (with specified exceptions) is prohibited, except under licence of the Minister of Transport (*Emergency Powers (Defence) Acquisition and Disposal of Motor Vehicles Order*, 1940, No. 1352).

The acquisition or disposal of aluminium and aluminium alloy requires a licence from the Minister of Aircraft Production (*Control of Aluminium (No. 5) Order*, 1940, No. 1449).

Caustic potash and carbonate of potash is controlled by the *Control of Caustic Potash Order*, 1940 (No. 1475).

Copper, lead, and zinc are within the scope of the *Control of Non-Ferrous Metals Orders*, 1939 (No. 1812) and 1940 (No. 206).

The production and distribution of sulphate of ammonia and the fixing of maximum prices is regulated by the *Control of Fertilizers (No. 7) Order*, 1940 (No. 1899).

Maximum prices for iron and steel products are prescribed by the *Control of Iron and Steel (No. 8) Order*, 1940 (No. 496), which has been varied by subsequent Orders down to the *Control of Iron and Steel (No. 13) Order*, 1940 (No. 1910). It is necessary to acquire licences for the purpose of using scrap iron (*Control of Iron and Steel (No. 14) Order*, 1940 (No. 2076)—which fixes maximum prices for such scrap.

The supply of specified machinery and plant—except to Government departments or for export—is restricted to persons having licences from the Minister of Supply or in respect of the repair of parts (*Machinery and Plant (Control) Order*, 1940 (No. 1363). This Order is varied, in regard to office and other specified machinery and plant by the *Machinery, Plant and Appliances (Control) Order*, 1940 (No. 2179).

The production, consumption and disposal of sulphuric acid, and basic prices, are controlled by the *Control of Sulphuric Acid (No. 2) Order*, 1940 (No. 615).

The supply of timber is regulated by the *Control of Timber (No. 13) Order*, 1940 (No. 1098), but this restriction does not apply to veneer required by local authorities and public utility undertakings for urgent repair work (*Directions No. 1*, Statutory Rules and Order No. 1099).

Toluene and toluole prices are fixed and licences for sales are prescribed by the *Control of Toluene (No. 2) Order*, 1940 (No. 1150).

Licences must be obtained from the Minister of Supply for the disposal of machine tools.

Other " control " Orders are briefly noted :

Industrial Ammonia (1940, No. 1589) ; *Mica* (1939, No. 1357) ; *Nitric Acid* (1940, No. 1975) ; *Paper* (1940, No. 1996).

It has been announced that other primary products of tar distillation are to be the subject of a " control " Order.

Mortgages, debentures, &c., charged on controlled materials are exempted by the *Ministry of Supply Control Orders (Exemptions) (No. 1) Order*, 1940 (No. 1951).

Under this regulation the Minister of Supply is empowered to issue priority certificates in respect of the carrying out of work and the supply of materials (*Priority of Work Order*, 1939, No. 1080).

The acquisition of licences and the keeping of records are prescribed by the *Petroleum (No. 1) Order*, 1940 (No. 55).

Coal.—The distributors' margin is limited by reference to the sales in the twelve months preceding the outbreak of war or by an order of the Secretary for Mines (*Wholesale Coal Prices (Inland) Order*, 1940, No. 798).

No coal-mine owner or Executive Board may sell coal at other than the " permitted price," which is defined in the *Coal Prices (Inland Supply) Order*, 1939 (No. 1557) as the price specified in any contract subsisting at Nov. 3, 1939, with the addition of 1s. per ton. A further increase has been sanctioned by the Secretary for Mines as from Nov. 1, 1940.

The Central (Coal Mines) Scheme, 1930, established under the Coal Mines Act of that year, has been amended to provide that a levy at a uniform rate not exceeding 6d. per ton may be raised for the purpose of facilitating the production, supply or sale of coal (S.R. & O., 1940, No. 2151.)

The retail prices of coal, coke and manufactured fuel are limited to those obtaining immediately prior to Sept. 3, 1939, subject to variations sanctioned by the Local Coal Officer (*Retail Coal Prices Order*, 1940, No. 1062). It is to be noted that the *Fuel and Lighting Orders*, 1939 and 1940 (referred to above), are still applicable in respect of the rationing of coke.

Factories and other undertakings are required to keep records of their products and staff (*Factory Undertakings (Records and Information) Orders*, 1940, Nos. 451 and 817). An obligation to keep and produce books, accounts, and records is imposed by the *Industry (Records and Information) (No. 1) Order*, 1940 (No. 818), on those upon whom a notice under this regulation is served.

Regulation 55 (4) provides for the control of an undertaking and for the carrying on of its business. In view of the ruling of Bennett, J., in *E. H. Jones (Machine Tools) Ltd.* v. *Farrell and Muirsmith* (1940), that this action was invalid as being *ultra vires* the original provisions, a revised regulation is now substituted.

Regulation 56 empowers the Board of Trade to direct the manner in which a public utility undertaking is carried on and to relax any statutory obligation or limitation.

Under this provision Orders have been made which modify the terms of the Gas Works Clauses Act, 1871 (*section 11*), the Gas Undertakings Act, 1934 (section 14), and the Gas Regulation Act, 1920 (*section 9*), in order to protect gas undertakers from the statutory penalties consequent upon failure (as a result of war damage) to maintain a normal supply of gas (*Gas Supply (War Damage) Order*, 1940, No. 1647) or to maintain the declared calorific value (*Gas Supply (War Damage) (No. 2) Order*, 1940, No. 1675).

The Board of Trade had previously issued (under this regulation)—first, the *Defence (Gas Charges) Order*, 1939 (No. 1788), which permits variations in the " maximum " or " standard " prices charged by gas undertakers, by virtue of a Gas (Charges) Order, and the application of profits—in circumstances where there is a prescribed decrease in the quantity of gas manufactured, and secondly, the *Defence (Gas Charges) Order*, 1940 (No. 385), which amends the foregoing and affords a similar measure of relief where the undertaker experiences an increase in the net cost of coal and oil. The 1939 Order is further amended to enable its adoption by gas undertakers in circumstances where the charges made by them for the hire of meters or fittings exceed the charges in force at the date of the outbreak of war *solely* by reason of the payment of Purchase Tax upon that meter or fitting (*Defence (Gas Charges) (No. 2) Order*, 1940, No. 2099).

Under this regulation also orders have been made by the Board of Trade for the purpose of varying the declared calorific value of gas supplied.

Regulation 56 A enables an application to be made to the Board of Trade by a gas undertaker for the construction, reconstruction, or structural alteration of its works or buildings.

Regulation 56 B empowers the Board of Trade to divert consignments of coal.

Regulation 58 A provides that the Minister of Labour and National Service may direct the control of employment. Under this provision have been issued :

(i) *Undertakings (Restriction on Engagement) Order*, 1940 (No. 877), which precludes employers in specified industries from seeking to engage workers except through a local employment exchange.

(ii) *Undertakings (Inspection) Order*, 1940 (No. 891).

Reference should also be made to the *Control of Employment Act*, 1939 (referred to in an earlier part of this article).

Regulation 58 AA empowers the Minister of Labour and National Service to make provision for the avoidance of strikes and lockouts. Thereunder the Minister has constituted the National Arbitration Tribunal for the settlement of Trade disputes (*Conditions of Employment and National Arbitration Order*, 1940, No. 1305).

Regulation 58 AB provides, *inter alia*, that the Minister may amend directions under the Holidays with Pay Act, 1938.

Regulation 60 empowers the Minister to provide for securing the safety, health, and welfare of factory workers.

Orders under this regulation include :

(i) *Factories (Medical and Welfare Services) Order*, 1940 (No. 1325), by which nursing and first-aid services may be required to be made available for persons directly or indirectly connected with the manufacture of munitions.

(ii) *Factories (Canteens) Order*, 1940 (No. 1993), which may be made applicable to such factories employing more than 250 persons.

(iii) *Factories (Glass Protection) Order*, 1940 (No. 2013), which applies where more than 250 persons are employed, requires the provision and maintenance of fencing and other protection from broken glass.

Regulation 60 B suspends the operation of committees of investigation and the central appeal tribunal set up by the Coal Mines Acts, 1930 and 1938.

It is to be noted, however, that coal consumers may apply to the Central Price Regulation Committee, set up under the *Prices of Goods Act*, 1939 (S., N.I.).

Regulation 69 empowers the Minister of Transport to take control of the railways. This was done by the *Railway Control Order*, 1939 (No. 1197), and thereunder was issued the *Railways (Demurrage*

Charges) *Order*, 1939 (No. 1822), which authorizes charges to be made for the detention of railway companies' wagons, containers, and sheets beyond the respective " free periods " defined in the schedule to the Order. These charges are not applicable to the conveyance of coal, coke, and patent fuel where it is operated under a system of control approved by the Minister.

Regulation 100 defines, *inter alia*, " public utility undertakings " (for the purposes of these *Regulations*) ; an undertaking authorized by any Act (whether public, general, or local) or by any Order made under, or confirmed by, an Act, for the supply of gas (including such an undertaking carried on by a local authority) is within its meaning.

II. Sulphate of Ammonia (Charges) (No. 1) Order, 1940 (No. 1177).

The Treasury is empowered, under section 2 of the Emergency Powers (Defence) Act, 1939, to recover the charges incurred in connexion with any scheme of control ; this Order provides that a producer of sulphate of ammonia shall make the appropriate payment to the Minister of Supply in respect of deliveries for use as fertilizers.

III. Defence (Petroleum) Regulations, 1940 (No. 749).

The Petroleum Department of the Board of Trade was established under these regulations.

IV. Defence (Evacuated Areas) Regulations, 1940 (X.N I.) (No. 1209).

Persons in " evacuated areas " are relieved from the payment of rent, rates, and other local debts, while provision is made as regards the preservation and disposal of their goods. The Regulations also extend the provisions of the *Courts* (*Emergency Powers*) *Act*, 1939, to cover circumstances arising in the evacuation areas. Sums due under a hire or hire-purchase agreement entered into before July 10, 1940, are not recoverable as long as the premises in which the appliances have been fixed are within such an area and are unoccupied.

V. Defence (Finance) Regulations, 1939 (No. 1620—as amended).

The Control of Capital issues (*Regulation 6*) is modified, in respect of public utility companies, by the *Capital Issues* (*Exemptions*) *Order*, 1940 (No. 2187).

VI. Defence (Companies) Regulations, 1940 (No. 1687).

Provision is made for the modification of the Companies Act, 1929.

VII. Defence (Bodies Corporate and Trade Unions) Regulations, 1940 (No. 1884).

Statutory and other specified companies are empowered to apply their funds for public or charitable purposes connected with the war.

The Minister of Transport has made, *inter alia*, the following Orders : *Motor Vehicles* (*Gas Propelled Vehicles*) (*Variation of Speed Limit*) *Regulations*, 1940 (No. 1065)—under section 10(4) of the Road Traffic Act, 1930—which remove the disabilities attaching to vehicles with trailers, when such trailers are for the sole purpose of enabling the vehicle to be propelled by gas.

Motor Vehicles (*Gas Container*) (*Amendment*) (*No. 2*) *Provisional Regulations*, 1940, which specify the conditions applicable to such vehicles.

Under the provisions of section 6 of the Petroleum (Consolidation) Act, 1928, the Home Secretary has made the *Compressed Gas Cylinders* (*Fuel for Motor Vehicles*) *Conveyance Regulations*, 1940 (No. 2009).

PATENTS

Gas Fire Efficiency

A patent (No. 526,870 ; application date, March 28, 1939) granted to the Parkinson Stove Company and H. T. Angus seeks to improve the efficiency of gas fires by preheating the air for combustion.

Fig. 1 is a sectional side elevation of one form of gas fire according to the invention. In the fire illustrated, 10 is the frame or body of the fire and 11 is a refractory grid or radiant which is spaced from a refractory back block 12. The grid or radiant is heated by the flames from burners 13 which are directed into the lower end of the space between the grid and the back block. The products of combustion leaving the upper end of this space are directed by a curved plate 14 into a cast or other flue outlet 15 extending through the back wall 16 of the fire and adapted to lead the products of combustion into a chimney or flue. The burners are shut off from the chamber 17 in the lower front part of the fire by a sheet metal partition 18 which extends horizontally for some distance towards the back of the fire and then upwardly parallel to but spaced from the back surface of the block 12. The partition terminates a short distance above the upper end of the block. A further partition 19 parallel to and spaced from the partition 18 and from the back wall 16 of the fire terminates at its upper end a short distance above the upper end of the partition 18, and at its lower end the partition 19 terminates short of the bottom of the chamber 17. A sheet metal backing 20 for the back block is carried p above the block to the level of the upper end of the partition 19 and the space between them is closed by a plate 21 having fins 22 extending downwardly on each side of the partition 18 and upwardly into the space below the plate 14. The plate 14 also carries fins 23 extending downwardly between the fins 22 and extending upwardly into the space within the canopy 24 of the fire.

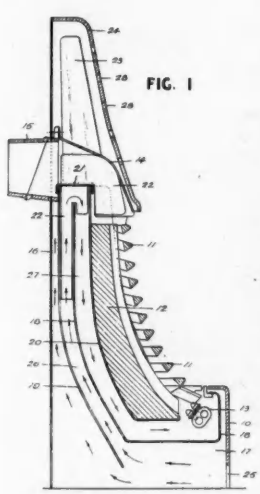


FIG. 1

An air intake opening 25 is provided in the front of the chamber 17 and a part of the air entering the chamber flows upwardly through the passage 26 between the partitions 18 and 19 and flows over the fins 22 and then downwardly through the passage 27 between the partition 18 and the back block to the burners. The fins 22 are heated to a high temperature by the passage of the products of combustion over the parts of the fins above the plate 21, and a portion of this heat is taken up from the parts of the fins below the plate by the air which is further heated as it passes downwardly over the back block on its way to the burners.

The remainder of the air entering the chamber 17 flows upwardly between the partition 19 and the rear wall 16 of the fire and flows over the parts of the fins 23 above the plate 14 and takes up heat from them, and the heated air is discharged into the room through openings 28 in the canopy 24.

Conveyor Lubrication

Lubrication of conveyors is the subject of a patent (No. 527,679 ; application date, April 19, 1939) taken out by Sir F. J. West, E. West and West's Gas Improvement Company, Ltd. It relates to the lubrication of the runner wheels and chain links of conveyors by means of grease guns which engage automatically with nipples on the runner wheel axles as the conveyor travels during its ordinary service.

In accordance with the invention, each grease gun is pivotally mounted in a swinging frame which can move laterally with relation to the direction of travel of the conveyor for the purpose of allowing the grease gun to accommodate itself to any lateral movement of the conveyor with reference to the normal path of pivotal movement of the grease gun. Springs of adjustable tension maintain the frame in a central position.

The grease gun is held against an adjustable stop by a spring and when in that position its nipple end is so located that it will be engaged by the successive nipples on the conveyor chain links which couple the conveyor wheel axles. When the grease gun is so engaged, the conveyor wheel passes over an obstruction or projection in its track, which may be in the form of a roller, and this gives the necessary stroke to the grease gun to cause grease ejection in the usual way.

The roller or obstruction in the conveyor wheel track may be lowered clear of the track when greasing is not required.

The adjustable stop associated with the grease gun ensures the nipple end of the grease gun being in correct position for engagement by the nipples on the conveyor and also ensures the necessary arc of travel of the grease gun while in engagement with the nipples.

Welded Gasholders

Patent No. 528,401 (application date, May 5, 1939) relates to welded gasholders. It has been granted to Ashmore, Benson, Pease & Co., Ltd., and C. F. Hunter. The patentees state that in the erection of gasholders from steel sheets or plates welded together, it has been usual to weld the seams externally and internally between the various lifts of the telescopic holder. The space, however, between the concentric lifts is extremely restricted and inconveniences the welder.

According to the invention plates are assembled and the seams welded on one side of each lift, whereupon the lifts are progressively raised by inflation of the gasholder and the opposite side of the seams of each lift is welded.

By this means, it is claimed, easy access can be available for the welder even where the space between the consecutive lifts is very small, the method of the invention, moreover, allowing the space between the lifts to be considerably diminished.

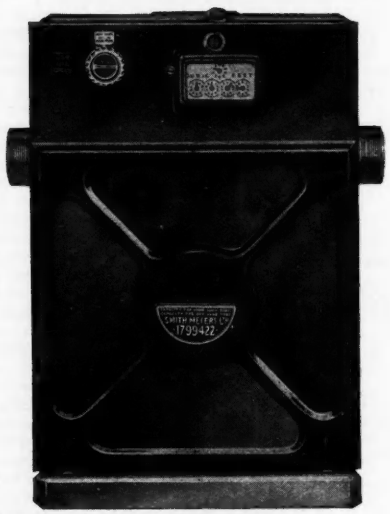
METERS FOR TRANSPORT
GAS FUELLING

A SMITH PRODUCTION

REGISTERS VOLUME TO INFLATE CONTAINER IN MINIMUM TIME AT DISTRICT PRESSURE

MOUNTED UPON SOLID REINFORCED CONCRETE BASE SECURELY BOLTED DOWN

BACK VIEW



SPECIFICATION

1. **CASING—18 gauge**
2. **RADIAL VALVES**
3. **GEAR BOX**
4. **INDEX at back. Total cons., 10 million c. ft.**
5. **DIAL. 15 inch with ⅛ plate glass**
6. **OILING TO 4 POINTS**
7. **POINTERS. Set to zero in one operation**
8. **PAINTED. Two coats lead priming and finishing. Coat to order.**

SMITH METERS LIMITED

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POST-WAR NATIONAL FUEL POLICY*

Outstanding Problems, and a Call for Teamwork in their Solution

By JOHN D. TROUP, M.I.Mech.E., M.I.Chem.E., F.Inst.F.

WE are approaching a period in the development of human effort which will reveal a new world order. Nations of the world will be on a common basis to a degree that has never before existed. We have seen the changing world conditions since the days when this country was the workshop of the world ; and we are now to witness the changes when the nations of the world will consolidate their own industrial and other activities into a world pattern, of which we as a nation will only be a part.

The importance of the part we shall play will be dependent upon how we plan for that part ; when, it would seem, we will have to keep in mind two main outlooks—namely, our overseas activities, and the development of home activities.

Although it has not been expressed very widely, there is a widespread feeling that the Institute of Fuel will play an important part in the new order of things that lie ahead. The importance of our responsibility is evident when we remember that the wealth and greatness of this country have been built up on the basis of our native fuel. Other nations have since followed our example. We, however, are still using our native fuel in the same primitive manner that it was used at the beginning of the industrial era, with the exception of the carbonizing industry, where again we lead the world, but this industry deals with only a relatively small proportion of our annual coal consumption. It is true that we are also transmitting our fuel energy more effectively by the medium of electricity, but here again we are using our fuel in the same primitive manner, even though combustion is carried out in a highly scientific manner. A very large proportion of our native fuel is also still used in a primitive domestic grate and in small furnaces.

There are two principal defects in this primitive use of our native fuel—namely, the pollution of the air we breathe, and the loss of products which have a higher value than raw fuel. There is also another important aspect of the problem. Modern conditions require the application of heat in a manner that will give the highest efficiency for a particular process, and this requirement cannot be met efficiently by using our native fuel direct ; it must first be transformed into the gaseous or liquid state, or converted into electricity.

These thoughts are not new. They have been pondered over and given expression to by eminent authorities during recent years ; but there has so far been no co-ordinated effort to formulate a plan whereby we could use our native fuel in a manner to conform with the conditions of our modern age.

We may, perhaps, see the picture more clearly if we project our minds into the future and set up an ideal goal. We cannot, however, look beyond the limits of modern economics ; but it may be within this limit to visualize conditions where the whole of our fuel energy would be provided by smokeless solid fuel, and liquid and gaseous fuels, which would automatically mean the recovery of so-called " by-products " and at the same time at least eliminate the emission of smoke to the atmosphere.

Past Efforts

Many efforts have been made in recent years to travel along the road leading to some such ideal ; and although such efforts have doubtless been very valuable as a guide, they have not resulted in a definite movement. After the last war the Samuel Commission made a most comprehensive inquiry into our fuel problems, and in their recommendation for a National Supervisory Body gave emphasis to the following : " No comprehensive survey has been made of the heat, light, and power requirements of various industries, or of the country as a whole, and how they can be most economically met by the various processes at present commercially feasible ; still less has the broad question been considered from the point of view of possible development in the future." The Commission considered that such a survey was imperatively required and that the survey should be undertaken by a body of a permanent character.

Since the Samuel Report was published the problem has been dealt with by many authorities, and the keynote of all their efforts may be said to be co-ordination. Members of this Institute will be familiar with these efforts, and the list includes such names as Sir Arthur Duckham, Lord Hirst, Lord Cadman, Sir Philip Dawson, Professor Egerton, Colonel Bristow, Mr. Boon, and many others.

In addition to the above efforts there have been published certain Government Reports, as well as " Labour's Plan for Oil from Coal." It is also significant that the subject is so frequently raised in the House of Commons by means of question and answer.

We see, therefore, that there is a mass of authoritative opinion urging us on to a more scientific utilization of our native fuel. But during the period these efforts have been made, the need for action has been gradually becoming stronger, and to-day there would seem to be an overwhelming case for consideration by a representative body, competent to compile a national plan.

Some Advantages of a National Scheme

Consider now some of the advantages to be derived from a National Policy. Looking at the subject broadly we can visualize higher efficiencies. With solid smokeless fuel we have a relatively simple product when compared with that complex compound bituminous coal. Such a smokeless fuel can be used efficiently by relatively unskilled labour, and doubtless apparatus would be developed still further to simplify the process when it became the one class of solid fuel available. Fuels in the liquid and gaseous state are ideal for purposes of control, and their extending use for special processes is evidence of the higher efficiency obtained when fuels of this nature are available.

The ideal we are considering naturally means the processing of raw coal by various methods. It is not proposed to deal with such methods in detail here, as that is a problem for teamwork, and would come up for consideration when the appropriate body comes into existence for the detailed consideration of a National Fuel Policy. It is, however, evident that our ultimate ideal would mean the building up of a great new industry, possibly in conjunction with the existing carbonizing industries. Such a development would be the means of creating new wealth and increasing employment and all the subsidiary advantages resulting from the development and operation of a new industry.

We are in a very much better position to deal with this problem to-day than at any previous time, due to the great advance in our knowledge of the complex nature of coal and the records of the various seams which have been compiled in recent years by the Fuel Research Station. Unfortunately, we have not made similar progress in compiling statistics on the utilization side, and it would seem that this is one of the first things we shall have to deal with.

The development of a national coal-processing industry would be the beginning of a plan which would ultimately abolish the emission of smoke to our atmosphere. There would remain the problem of acid fumes and dust discharged to the atmosphere, but this would come up for consideration when the detailed plan was under review. A great effort has been made in recent years to educate public opinion regarding the harmful effects of atmospheric pollution, and this work will doubtless be a valuable asset in helping forward a National Scheme. Some progress has already been made by the extending use of smokeless solid fuel, and also in the use of gas and electricity for heating purposes. There still remains, however, the open domestic grate, which uses a large percentage of our annual production of raw coal. The solution of this particular problem is one of vital importance, from both human health and economic points of view, and its importance has long been before us. It may be of interest to recall that at the beginning of the modern gas-producer era the late Dr. Ludwig Mond visualized a smokeless England through the medium of the total gasification of coal.

Since those days our knowledge of coal and its potentialities has increased at a rate which must have been beyond the vision of any ordinary mind. Thus, to-day, when we consider the vast field open to processes using coal as the basic raw material, we see, not one new industry, but a multitude of industries within practical vision, and others ahead if we only have the faith and the courage to provide a much greater organization for research. It has become a custom to refer to the products derived from raw coal as by-products ; but it would seem that the time has arrived to view the matter from a new angle, and

* Paper before the Institute of Fuel, Feb. 12.

consider coal as the raw material for a manufacturing process providing a multitude of products required by the age in which we live. This section of a National Fuel Policy is one of the very greatest importance, and one holding potentialities which seem to offer possibilities of development on a grand scale. And here we should also remember that we have a virgin field for building up home industries which would not only be of great value in strengthening our financial position as regards balance of trade with other nations, but would also provide new and enterprising openings for the " boys " in the Services when they return again to normal human life. It may also be recorded that a fair percentage of those who return to civil life will have had a training in our mechanized services which will be helpful in the new world which lies ahead.

It is common experience that new developments bring in their train advantages and conveniences which are not always obvious in the initial stages, but in a National Scheme such as is now being considered there are advantages and conveniences which evolve as the picture becomes more complete. One feature, for example, is fairly clear—that we would have available fuels in a relatively simple form which would tend to standardization in fuel-consuming equipment. Such equipment would further develop automatic control, and it is possibly within the bounds of practical vision to picture all our heating and power plant operating under automatic control, when the personnel would be required only for supervision and maintenance. The use of fuel in the gaseous state would be developed together with extensions to the grid system which, together with other service supplies, would bring into being a system of underground service tunnels, and abolish the present crude system of the continuous use of pneumatic drills in our busy thoroughfares, a method which must become more and more inconvenient due to increasing traffic density. Still another possibility in this co-operative scheme is the pooling of heat energy supply by groups in industrial areas.

Fuel for Transport

In addition to the fuel requirements of industry, business premises, and domestic, there is the vast field of transport by land, sea and air. This field calls for very special consideration in any national fuel scheme, principally because the fuel should be in a form for convenience of handling, and provide the maximum heat energy in the minimum of space and weight. To-day the greater part of the fuel used for transport is in the liquid form. Our railways and merchant ships still use a considerable amount of solid fuel, but in these sections we are experiencing a change over to electrification and the use of liquid fuel, each of which may, of course, be derived from our native coal. In this case, however, the liquid fuel is at present largely shipped from overseas ; but this is only one problem which has to be considered when the details of a national scheme are planned.

The transport side of the fuel problem would seem to open up vast possibilities, and at the present time we naturally have in our minds the problem of defence, and doubtless the post-war period will still hold this particular aspect of the problem. We have, however, witnessed a number of interesting developments during recent years which have been devised to use fuel by other methods. These include compressed gas, producer gas, and liquid fuel derived from raw coal by different systems. These and other methods seem to hold potentialities which must have an important bearing on any national fuel scheme.

It would seem, however, that it is the problem of liquid fuel that calls for immediate attention. Transport by air is only in its infancy, and as our present methods are capable only of using liquid fuel it is clear that the liquid fuel demand in this field will be an ever increasing one. When, however, we come to consider the supply of such liquid fuel from raw coal we immediately come up against the problem of how to deal with the other resulting products unless the coal is totally converted into the liquid state. This would seem to be one of the major problems to be considered by any body endeavouring to plan a national scheme.

Distribution of Heat Energy

Still another factor in a national fuel scheme is the distribution of the heat energy. Properly designed underground tunnels have been visualized for conveying our different services, which would include water, gas and electricity. But there is another factor which would appear to demand serious consideration—namely, the distribution of heat energy in the form of steam. There is considerable experience available in different parts of the world to-day, where data may be obtained to guide us on this aspect of the problem. The city of New York has been steam heated through the medium of underground mains for more than fifty years ; but although there is considerable experience available in America there has been no serious attempt to utilize the steam in a prime mover before delivering it to the street mains. In Europe, however, there is experience on a fairly extensive scale, particularly in Russia, where central power stations have been designed for the definite purpose of supplying steam heat to wide districts after the steam has first been used to generate electricity.

This aspect of a national fuel policy is primarily one of geography, in other words, one of finding the heating load in order to evolve an economic plan. There would appear to be no serious technical difficulties ; and if it were possible to arrange our electric power stations in such a manner that condensers were eliminated, and the latent heat of the steam utilized for a useful purpose, then we would have increased the efficiency of our most modern electric power station by a figure in the order of 100%. We see, therefore, that the incentive to consider this particular matter fully is one of major importance.

Economics of the Scheme

Turning now to the economic side of a national fuel policy it would seem important that we maintain a flexible mind on this aspect of the problem, and take the longest view possible. The balance sheet must be the test, whether it be a trading concern or the State, but the details of the balance sheet are a flexible quantity. We are living in an age where there seems to be a widespread feeling that we must revise our outlook on the whole problem of economics, and one does not require to be an expert to see the great importance of this trend of modern thought.

Our present-day national expenditure gives us some clue as to what we might do under peacetime conditions if we only planned for co-ordinated progress. Much money will be required for research. but the results of properly conducted research ultimately show a credit balance. We cannot form an opinion on the economics of a national fuel policy until a definite plan of campaign has been formulated, but there is one aspect of the plan which may be suggested here. It may be assumed that any national fuel scheme would visualize the ultimate abolition of smoke from the atmosphere. At present we know that the damage caused by smoke is costing the community an annual sum of money running into millions of pounds sterling, not to mention the damage to human health. When the day arrives that no smoke is emitted into the atmosphere, these annual millions of money will be saved, and in the intervening period of time will be a gradually reducing quantity. Is it not possible to capitalize this heavy annual expenditure to assist the balance sheet of any proposed national fuel policy ? It may be of interest to record here an extract from the paper read by Dr. Owens at the Institution of Mechanical Engineers in 1936, entitled " The Smoke of Cities ":

"An attempt to estimate the cost of smoke was made in 1912 at Pittsburg, and it was then calculated that the cost per head of the inhabitants amounted to $20 per annum. In 1918 another attempt was made in Manchester, in which the Manchester Air Pollution Advisory Board based their estimation on the same methods, and this resulted in a figure of over £1 per head of the population. The average deposit of impurity from the air in these two towns was 360 tons per square mile per annum in Manchester during 1917–18, and 1,031 tons per square mile per annum in Pittsburg during the period of the investigation. The Author has suggested as a basis for estimation, accepting the Pittsburg estimate and assuming that the cost varies directly with the amount of deposit from the air, that if this deposit in tons per square mile per annum is denoted by S, then the cost per head of the population would be S/11.9 shillings. When applied to London, the cost per annum since about 1922 would be approximately 24s. per head. The method is somewhat crude, but it gives a figure which is probably approximately accurate."

On the economic side there is also the question of coal exports, where we have had to face a dwindling market. If we cannot export wealth in the form of coal we naturally have to turn to other products, and this phase of the problem would seen to be an important factor in considering the economics of a national plan.

Putting the Policy into Action

Now we come to the problem of putting a national fuel policy into action. We have referred to some of the efforts made during recent years towards this goal, but one must, perhaps, come to the conclusion that, like many pioneers, they were before their time. The facts are, however, that they only aroused a certain interest and then went on record. There followed no movement to action. This is the central thought

behind these notes ; and if the time has arrived now for action, what is the best way to set to work ?

It is clear that no definite movement towards a national goal will take place until the full weight of authority is behind the movement. For such a movement to have the full weight of authority a plan must be devised by the co-operation of the authorities in each branch of activity concerned with fuel problems. With such a plan backed by authoritative opinion throughout the country the problem of a national fuel policy would be more than half solved, and it should not be an impossible proposition to put the plan into being.

On the principle that a small committee is generally more effective than a large one, it is proposed that in the initial stage a small committee be formed by representatives of each of the Institutions more directly concerned with fuel problems. Such a committee would consider the problem from the point of view of forming a skeleton plan. When this stage of the work has been reached some of the difficulties would be revealed, and also where further advice and assistance would be required. By such stages the committee could be enlarged and strengthened when required, and so build up a representative committee which would embody the authorities of the major activities of our technical, industrial and commercial life.

This Institute would seem to be the natural starting point for such a movement, and these notes have been compiled to give an opportunity for ventilating ideas and opinions on the subject of a national fuel policy, the drafting of which calls for teamwork covering a wide range of problems.

THE INSTITUTION OF GAS ENGINEERS

SECOND ARTHUR DUCKHAM RESEARCH FELLOWSHIP REPORT*

The Radiation from Solid Substances Under Flame Impact : Part 1

[Communication No. 237]

(*Concluded from p. 256*)

With these considerations in mind it was decided to prepare two specimens of calcium oxide containing manganese and bismuth respectively. This was done by precipitating the carbonate from solutions containing approximately 1 per cent of the "activating" elements, and subsequently igniting to the oxides. On exposure to the flame these specimens were found to give an intense luminescence, very much brighter than that previously observed with the impure oxide. The emission from the manganese activated sample was golden-yellow in colour and that from the bismuth specimen violet. It was confirmed that the luminescence occurs only in the edge of the flame, and while the temperature of the surface was between certain limits. In particular, the luminescence faded as the surface approached red heat.

Other Luminescent Substances

A survey has been made of the effect of a number of other elements as activators in calcium oxide. Among the most effective activators found from the many substances tested, in addition to those previously mentioned, are antimony (bright blue luminescence), and praesodymium (pink). Tin and lead gave positive but much less intense results, the colour being bluish in each case. It is probable that many of the rare earth elements would behave as activators, but difficulty has been experienced in obtaining specimens of these elements.

The calcium oxide has been replaced by the oxides of strontium and magnesium, with the same activators. The results obtained suggest that the luminescence with a particular activator is very similar if not identical with each of the parent substances. Beryllium oxide can also take the place of calcium, strontium or magnesium, but few specimens have been prepared owing to the relatively high cost of the pure oxide. It seems probable that barium oxide should also behave similarly, but attempts to prepare specimens have failed owing to the difficulty of producing the oxide by ignition of the carbonate. Specimens of alumina activated with 1 per cent of chromium have been prepared, but were found to be inactive, in contradiction to the results of Nichols, who claimed a high degree of luminescence for this mixture.

It must be emphasized that these results must be considered as merely a preliminary survey of potential active substances. This part of the work could be very greatly extended, but attention has of necessity been diverted to other aspects of the problem.

The Optimum Concentration of Activator

It is obviously of considerable interest, both from the practical and theoretical aspects, to determine the optimum concentration of activator for the production of this luminescence. Tests have been made with bismuth and antimony in calcium oxide. The position is complicated by the fact that the colour of the luminescence varies with the concentration of activator, passing to a deeper violet and a deeper blue respectively as the concentration of activator was increased. Judged usually, it appears that the maximum brightness is obtained with about 0·7 per cent of bismuth and 1·0 to 1·3 per cent of antimony. This result is rather surprising, since the optimum concentration for cathode-ray and ultra-violet luminescence is generally very much lower; no theoretical reason for this suggests itself.

Burners and Supports for the Luminescent Material

It has been mentioned that the luminescence occurs only in the outside edge of the hydrogen flame and that it disappears if the emitting surface approaches red heat. It is obvious that in order to secure the maximum radiant efficiency the whole surface of the flame should be in contact with the material. At the same time, the surface must be prevented from reaching a temperature of more than a few hundred degrees. Also, from an efficiency point of view, undue heating of the surface is wasted energy.

The problem of securing any form of mount which satisfied these conditions has proved very difficult. Any form of mantle is raised to a high temperature before it is actually in contact with the flame, unless the latter is allowed to oscillate at a high speed. After many tests, the most satisfactory results have been obtained by allowing the hydrogen to diffuse through a slab of porous brick, on the outer surface of which the luminescent material is placed. Very small flames form at each of the pores, and the whole surface is seen to glow brilliantly. Addition of a small amount of air or oxygen to the hydrogen causes a slight increase in luminosity, but further increase results in undue heating of the surface. This form of mounting has proved very convenient for the spectrographic examination of the emission, but is still unsatisfactory from the point of view of overall radiant efficiency, since only a part, probably between one-third and one-half, of the individual flames is in fact in contact with the material, while much energy is wasted in heating the porous slab and its supports.

The Use of Gases Other than Hydrogen

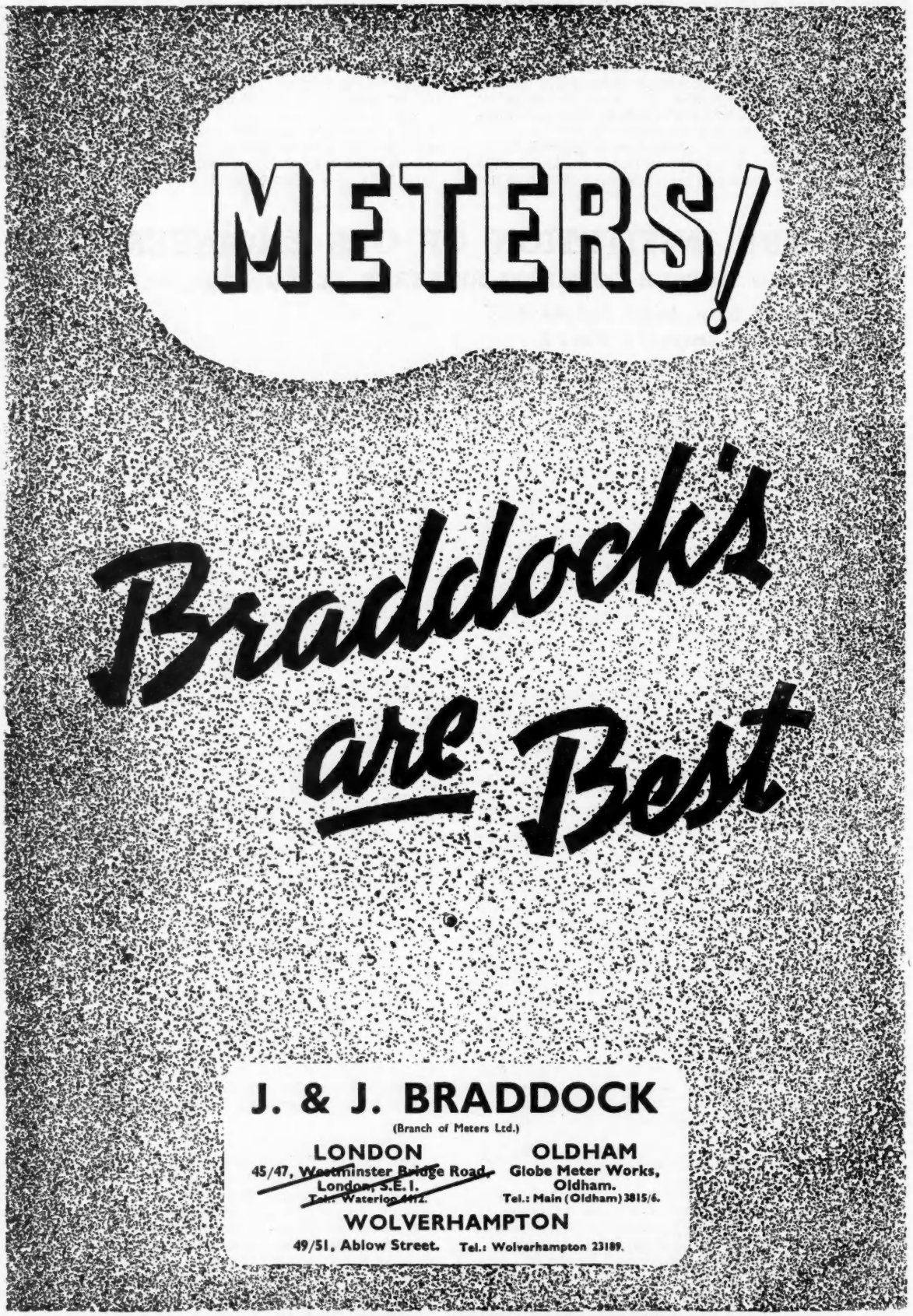
The effect of coal gas flames, both aerated and non-aerated, and of the addition of carbon monoxide to the hydrogen flame, have been the subject of a cursory examination only. The results appear somewhat erratic and contradictory, since some specimens glow in the coal gas flame in a satisfactory manner, though the intensity is in all cases much less than that in the pure hydrogen flame. Other specimens are apparently quite inactive in coal gas and the glow is quenched by the addition of a few per cent of carbon monoxide to the hydrogen flame. More work on this aspect of the subject is needed before any certain conclusions can be drawn.

Spectrographic Examination of the Emission

The spectra of the luminescence of bismuth, manganese, lead, praesodymium and antimony activated calcium oxides are shown in Figure 7, Nos. 1 to 5 respectively. It will be observed that, except in the case of praesodymium, the spectra are all broad bands of continuum, covering considerable portions of the visible spectrum. Praesodymium is unique in showing line structure superposed on the continuum. In all cases the spectra are similar to those observed in cathode-ray and ultra-violet luminescence. The spectra are in themselves sufficient to prove the luminescent nature of the emission. The

(*Continued on p. 298*)

* Research Fellow, E. C. W. Smith.



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Gas Products Prices

The London Market

Feb. 10.

There is no change to report in the prices of Tar Products in the London market, to-day's values being about as follows: Pitch is nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha 2s. 3d.; and 90/160 pyridine about 15s.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Feb. 10.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha, North, 1s. 5d. to 1s. 6d. Creosote, *ex* works, in bulk, North liquid and salty, 4½d. to 4¾d.; Scotland, 4¼d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10½d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, Feb. 8.

Distillers are comfortably placed on contract and new business during the week has been on a smaller scale. Prices are well maintained.

Refined tar is slow in the home market with price unchanged at 4½d. to 4¾d. per gallon, while for export there is a small but steady demand at 3¼d. to 3½d. per gallon, both f.o.r. naked.

Creosote oil is well looked after in this district, with prices remaining firm as under: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid can be secured quite readily at the following prices; Pale 99/100%, 2s. to 2s. 2d. per gallon; Pale 97/99%, 1s. 9d. to 1s. 10d. per gallon; Dark 97/99%, 1s. 6d. to 1s. 7d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha is only available in smallish quantities with value at round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha is changing hands at 1s. 8½d. to 1s. 9d. per gallon for 90/160 grade and 1s. 4½d. to 1s. 5½d. per gallon for 90/190 heavy naphtha.

Pyridines are quiet at about 17s. to 18s. per gallon for 90/160 grade, and 19s. to 20s. per gallon for 90/140 grade.

Where Consumers are Obliged to use gas for lighting during the daytime because their windows are boarded up as a result of enemy action, the Salford Light, Heat, and Power Committee are considering a suggestion for a cheaper tariff, such as is already applicable to large consumers.

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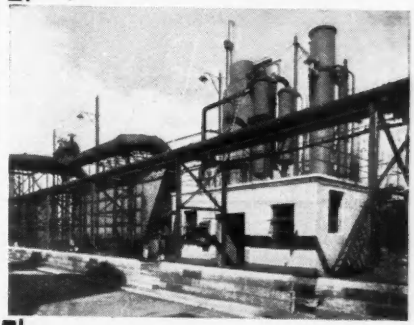

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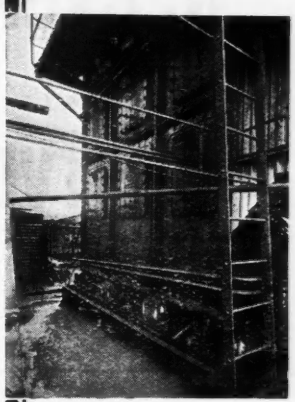

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GAS STOCKS AND SHARES

Although there were few signs of any broadening of business, most sections of the Stock Exchange were inclined to improve up to the middle of last week. Later, however, with the French political uncertainties and the probabilities of heavier taxation, the better tone was not maintained, although at the actual close prices had steadied. After a period of dullness British Funds recovered and showed no change on the week—2½% Consols remaining at 77½. Home rail ordinary stocks were dull ; but some improvement took place among a few of the preferences. Industrials generally were quiet and dull, only a very few of the leaders showing any resistance to the general conditions. Oils were no better, and there was little activity in rubber or tea shares.

Business in the Gas Market was also on a smaller scale last week and prices were inclined to weaken, especially among some of the fixed-interest stocks. In the Official List Gas Light 3¾%, South-Eastern 4%, South Suburban 5%, and Wandsworth 4% preference stocks were marked down, while on a widening of the margin Commercial ordinary reacted 2½ to 35. On the other hand Tottenham 5% preference was levelled up to 82½, showing a gain of 2. The only change of note in the Supplementary List was a drop of 5½ in Tunbridge Wells 4% stock to 69½. On the Provincial Exchanges Liverpool ordinary fell 6½ to 92 and Long Eaton 5% debenture closed 5 points lower at 89½.

Among the recent final dividend announcements it is observed that Derby has maintained its rate of 4½%, again making 7½ for the year. There is a small drop in the East Surrey final to 2½%, making 5% for the year against 5⅜% for 1939, while Portsmouth has dropped from £4 2s. to 3⅜%, a total of 7½% for the year against £7 14s. 6d. last year.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 6.	Rise or Fall on week.
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	103—108	...
374,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Asscd. Gas & Water U'd'ts Ord.	11/6—13/6	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	12/—14/—	...
561,370	Aug. 12	7	7	Barnet Ord. 7 p.c.	97—102	...
300,000	Oct. 14	1/9⅜	1/4⅜	Bombay, Ltd.	19/6—21/6	...
690,407	Aug. 19	7	7	Bournemouth 7 p.c. max. ...	105—115	...
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	79—84	...
659,955	Aug. 19	6⅜	4⅜	Brighton, &c., 5 p.c. Con. ...	65—75	...
855,000	Sept 30	8	6	Brit. Gas Light Ord.	75—85	...
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	73—78	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	½—1	...
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92*	−2
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref.	19/—21/—	...
764,169	Oct. 7	/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/—	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/—	...
1,748,935	July 22	2	3	Commercial Ord.	30—40	−2½
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Aug. 19	5	5	Do. 5 p.c. Deb.	87—92	...
807,560	Aug. 12	7	6	Croydon sliding scale	83—88	...
644,590	,,	5	5	Do. max. div.	75—80	...
620,385	Dec. 30	5	5	Do. 5 p.c. Perp .Deb. ...	90—95	...
179,500	Aug. 19	5⅜	5	East Surrey 'B,' 5 p.c.	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/—	...
19,123,018	July 29	3⅜	4½	Gas Light & Coke Ord. ...	12/—14/-a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	45—50	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	68—73	+1
2,993,000	July 8	3½	3½	Do. 3½ p.c. Red. Pref. ...	78—83	−4
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	69—74	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	100—105	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	99—104	...
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
5,600,000	May 13	4	8	Imperial Continental Cap. ...	44—49	...
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	62—67*	...
231,978	Aug. 19	5	5	M.S. Utility 'C' Cons.	68—73	...
918,657	,,	4	4	4 p.c. Cons. Pref.	72—77	...
675,000	Nov. 11	†4	†4	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	105—115	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	93—93*	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/—	...
597,972	,,	-/10⅜	-/10⅝	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/—	-/7½	South East'n Gas Cn. Ld. Ord.	8/—10/—	...
1,000,000	,,	-/10⅜	-/10⅝	Do. 4½ p.c. Red. Cum. Pref.	14/—16/—	...
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	11/6—13/6	−1/—
6,709,895	Aug. 5	4	4	South Met. Ord.	43—48	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	102—107	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	69—74	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. ...	58—63	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	97—102	...
1,543,795	July 22	3	4	South Suburban Ord. 5 p.c. ...	62—67	...
512,825	July 8	5	5	Do. 5 p.c. Perp. Pref. ...	80—85	−5
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	63—68	...
250,000	,,	3⅜	3⅜	Do. 3⅜ p.c. Red. Pref. ...	80—85	...
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Aug. 9	5½	5	Southampton Ord.	57—62	...
350,000	Feb. 12	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Aug. 5	5	5	Tottenham & District Ord. ...	62—67	...
338,555	,,	5	5	Do. 5 p.c. Pref.	80—85	+2
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/—	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/—	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/—14/—	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...
380,606	Aug. 5	7	6⅔	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	July 8	3½	4	Wandsworth Consolidated ...	66—71	...
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65	−3
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	90—95	...
383,745	,,	4	4	Do. 4 p.c. Deb.	75—80	...
558,342	July 15	6	5	Watford & St. Albans Ord. ...	85—90	...
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 6.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,, 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	83—88	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110*	...
295,932	Aug. 19	5	5	Cheltenham, 5 p.c. Cons. Ord....	88—93	...
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Aug. 12	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	65—75	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Aug. 19	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,, 19	6	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
117,425	Feb. 5	8	8	East Wight, 5 p.c. Cons. Ord. ...	100—110	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.... ...	65—75	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Aug. 19	5	5	Hampton C't, 5 p.c. Cons. Ord.	68—73	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	55—65	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	55—65	...
50,000	Aug. 19	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref....	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb. ...	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6½	6½	Tunbridge Wells, 4 p.c. Scale ...	67—72	−5½
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	88—93	...

PROVINCIAL EXCHANGES

					Quotations Jan. 31.	
47,756	July 26	6	5	Bath Cons.	94—98	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	July 15	5	5	Bristol, 5 p.c. max.	89—91	...
120,420	Dec. 16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	,,	5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Aug. 5	6½	5	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 16	4	4	Do. 4 p.c. Pref.	79—84	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Aug. 12	9	6	Derby Cons.	100—105	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	−2
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	165—175	...
6,500	,,	10	10	Do. 'B' Ord. ...	165—175	...
79,000	,,	10	10	Do. 'C' Ord.	155—165	...
732,000	Aug. 26	4	4	Hartlepool G. & W. Cn. & New	61—63	...
2,167,410	Aug. 19	6	6	Liverpool 5 p.c. Ord.	90—94	−6½
245,500	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref. ...	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb.	87—92	−5
2,430,267	July 29	5.7%	5	Newcastle and Gateshead Con.	16/6—17/6a	...
682,856	,,	4	4	Do. 4 p.c. Pref.	75—77	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July 26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept. 16	8⅔	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Aug. 5	8	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Aug. 26	6½	6½	Sheffield Cons.	114—116	...
95,000	Jan. 6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb. 5	6	6	Sunderland 6 p.c. max. ...	107—112	...
140,778	Aug. 12	5	5	Weston-super-Mare Cons. ...	80—85	...
64,338	Dec. 30	4	4	Do. 4 p.c. Deb.	80—85	+2½
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	135—140	−1½

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

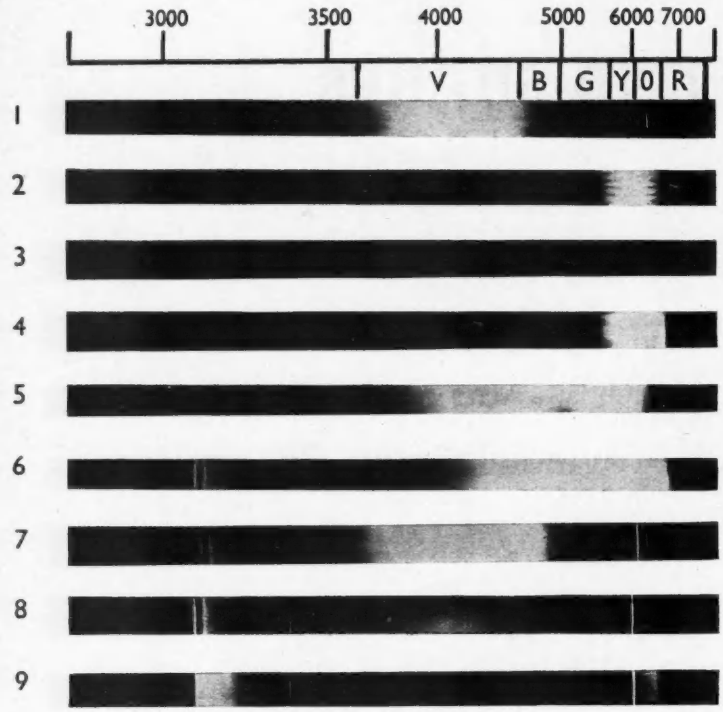

FIGURE 7.—*Spectrum of the Emission from Luminescent Oxides. The Scale Shows Wave-Lengths in Å, and the Colours of the Spectrum are Indicated by their initial letters.*

distribution corresponding to normal thermal emission at about 1,500°C. is shown for comparison in No. 6, and it is at once obvious that the distribution in the case of the luminescent substances is quite different from this.

Spectra Nos. 7, 8 and 9 are included to demonstrate the decay of the luminescence as the surface is allowed to approach red heat. A hydrogen flame, burning at a narrow jet, and allowed to impinge on a refractory slab coated with bismuth-activated calcium oxide gives the spectrum shown in No. 7. The OH bands and the D line of sodium emitted by the flame itself are also visible on the plate. A small amount of oxygen added to the gas stream raises the surface to incipient redness, causing the marked diminution in intensity of the luminescence shown in No. 8, while the bands and the sodium line are considerably enhanced. Still further addition of oxygen gives enough thermal emission for the red to be recorded on the plate (No. 9), but the luminescence is almost entirely absent, while the flame emission is greatly strengthened.

It is interesting to note that while the manganese, bismuth and praesodymium activators give rise to emission in fairly narrow bands of the visible spectrum, the radiation from the antimony and lead specimens is distributed uniformly through the visible region, with the exception of the red. It may be noted that the combination of praesodymium and antimony activated specimens would give a good approximation to the distribution of daylight.

VIII CONCLUSIONS

The work described had as its intention a rapid survey of the whole field of "candoluminescence" without any attempt at a detailed examination of particular aspects of the problem. It has served to establish beyond all doubt the reality of the luminescent phenomenon at low temperatures, and has shown that the observations of Nichols on the supposed luminescence at incandescent temperatures are capable of explanation on purely thermal grounds. For the reasons given in the introduction to this Report, the existence of a luminescent radiation from solids in contact with flame is of considerable significance, as offering what appears to be the only hope of a considerable increase in the efficiency of light production from the combustion of fuel gases. At the same time, it must be emphasized strongly that at present and with the data available to date, the practical application of these luminescent substances would appear to be beset with considerable difficulties. From its theoretical aspects the subject is of great interest owing to its bearing on the subject of luminescence in general, and very little attention has been given to it in the past, apparently on account of the unsatisfactory nature of much of the experimental evidence.

The survey of luminescent materials so far completed has provided information which will be valuable in the selection of further "activators" and parent substances. The establishment of a critical optimum concentration of any activator is of some importance. When other substances are examined it will be interesting to observe how this optimum concentration varies and on what factors it depends. The spectrographic examination, in addition to its theoretical implications, is of practical value in showing the distribution of the emission through the spectrum, and in demonstrating the possibility of securing almost any desired distribution, e.g., one approximating to that of daylight, by the choice of a mixture of two or more luminescent materials.

It is now clear that further investigation will resolve itself into four main fields.

1. The examination of other substances, both as activators and as parent substances for the production of luminescent materials. As this work progresses, the periodic relation of the elements will serve as a useful guide in the selection of suitable materials.

2. The consideration of the problem of using the activating flame with the greatest possible efficiency, i.e., the design of a suitable burner and support for the luminescent material. Also, the determination of the overall luminous efficiency of the various sources, the spectral distribution of their emission, and the use of gases other than hydrogen in the flame.

3. The elucidation of the mechanism of the process responsible for the luminescence, and the relation with cathode-ray and ultra-violet luminescence. This will probably involve experiments on the effects of atoms and active radicals produced in the exit gases of electrical discharges and of radiation of very short wave-length.

4. The investigation of the anomalous thermal behaviour in the high temperature range by means of infra-red spectrometry.

APPENDIX

LITERATURE REFERENCES

[1] *Ann. Physik*, 1905, **18,** 725; 1906, **20,** 593.
[2] *J. Franklin Inst.*, 1918, **186,** 403, 585.
[3] *Trans. Illum. Eng. Soc.*, 1940, **5,** 75.
[4] *Trans. Faraday Soc.*, 1939, **35,** 163; 1940, **36,** 505.
[5] *ibid.*, 1925, **21,** 474.
[6] *ibid.*, 1939, **35,** 179.
[7] *Phil. Mag.*, 1937, **23,** 345; *Nature*, 1940, **145,** 896.
[8] *Phil. Mag.*, 1842, **21,** 270.
[9] *Monatsh.*, 1913, **34,** 949.
[10] *Ber.*, 1918, **51,** (2), 1728.
[11] *Ber.*, 1920, **53,** 2206.
[12] *Z. Elektrochem.*, 1923, **29,** 303.
[13] *Z. anorg. Chem.*, 1925 **147,** 111.
[14] "Cathodo-luminescence and the Luminescence of Incandescent Solids", Nichols, Howes and Wilber, Carnegie Inst. Publn. No. 348 (1928).
[15] *Physical Rev.* (2), 1921, **17,** 453.
[16] *ibid.*, (2), 1923, **22,** 425; 1924, **23,** 472.
[17] *J. Opt. Soc. Amer.*, 1922, **6,** 42.
[18] *ibid.*, 1930, **20,** 115.
[19] *ibid.*, 1932, **22,** 170.
[20] *ibid.*, 1932, **22,** 351.
[21] *ibid.*, 1935, **25,** 57.
[22] *Physical. Z.*, 1930, **31,** 373; and *Z. Elektrochem.*, 1930, **36,** 784.
[23] *Trans. Faraday Soc.*, 1939, **35,** 170.